SYNOPSIS

TOXICITY DUE TO COPPER AND ZINC ON THE FRESH WATER FISH *PUNTIUS PARRAH* (Day, 1865)

The environmental quality of water bodies has deteriorated markedly over last two decades due to the continuous growth in population, rapid industrialization and the increased rate of discharge of pollutants into the environment. Water bodies especially rivers play a crucial role in assimilating or carrying industrial and municipal waste water, runoff from agricultural fields, roadways and other sources which are mainly responsible for water pollution. Among various organic and inorganic water pollutants, metal ions are toxic, dangerous and harmful because of their tissue degradation in nature. Among heavy metals, lead, mercury, arsenic and cadmium are highly toxic whereas heavy metals such as zinc, copper, chromium, iron and manganese, are required by organisms in trace quantities. But these same elements can be toxic in larger quantities, notably copper and zinc which make their way into water bodies by extensive use in agriculture apart from usage in various industries like textile, tanneries, paints, battery, laundry, photography, copper ware and piping for water distribution systems. The concentration of these elements above tolerable levels is a disturbance factor for species survival and ecosystem stability. In this regard, the more abundant metals such as copper and zinc may sometimes be of greater hazard. Toxic effects of heavy metals on organs and organ systems are a major theme in classical toxicology. Heavy metals become toxic when they are not metabolised by the body and they are accumulated in the soft tissues. Even though copper and zinc are essential for the growth and development of the organisms, higher concentrations have been reported to be toxic on different organisms.

This thesis on “Toxicity due to copper and zinc on the fresh water fish, *Puntius parrah* (Day, 1865)” presents a comprehensive study on the bioaccumulation of Cu and Zn as well as its acute and sublethal effects on the histological , haematological, biochemical changes in the fish, *Puntius parrah* by suitable bioassay methods. The thesis is divided into seven chapters and the first Chapter provides a general introduction on heavy metal pollution, its exposure effects and bioaccumulation that result in biochemical and haematological changes. Relevant review of literature emphasizes the importance of the present study and its objectives. The second Chapter gives an introduction on the exposure studies which include acute and chronic exposures supported by recent and past literatures. The General materials and methods for collection, maintenance of the fish its description are given in this chapter. The toxicity of the heavy metals copper and zinc on the fish *Puntius parrah* was assessed based on standard methods and LC_{50} was determined for 24, 48, 72 and 96 hours respectively by Probit analysis. The 96hr LC_{50} for copper was 0.5ppm and that for zinc was 9ppm. The results have been given with supporting tables and figures with detailed discussion, comparing with other similar works.

The third Chapter deals with the accumulation of Cu and Zn in water and sediment in five selected study sites of river Periyar along with details on the physico-chemical parameters. Zinc and copper in water and sediment showed high concentration particularly in the highly industrialized area compared to the non industrialized zones of the river. The sediment samples in station I (Kuzhikundam creek) had an average value of 19.855±0.125µg/g for zinc and that of 4.32±0.050 µg/g for copper. Similarly water sample from the same study area had an average of 16.26±0.250 µg/g for zinc and that for copper

was 2.59±0.090 µg/g. This chapter also explains the bioaccumulation of the selected heavy metals, copper and zinc on the test species *Puntius parrah*. The fish exposed to a sublethal concentration of 0.06ppm Cu and 0.9ppm Zn showed higher accumulation of both the metals in liver (Cu-78.824±0.052; Zn- 1083.4±1.140 µg/g) as compared to kidney, gills and muscles. All the results are discussed with relevant and related works. The Chapter 4 deals with the histological changes induced by copper (Cu-0.04, 0.06, 0.12) and zinc (Zn- 0.6, 0.9, 1.8 ppm) on the test organism under sublethal concentrations on 3^{rd}, 7^{th}, 14^{th} and 28^{th} days of exposure. Several histopathological changes were noted in gills, liver and kidney tissues attributable to Cu and Zn exposure. Photographs of the histological sections are the clear indication of the gradual and severe histopathological alterations induced by copper and zinc during the exposure period. Cellular changes were prominent and the results are discussed with relevant literature.

The fifth Chapter describes the biochemical changes of total protein, total fat and amino acid compositions on exposure to the heavy metals. At sub lethal concentration the total protein and fat content of the experimental fish decreased (protein- 50.2±2.236 to 32.5±0.291mg/100mg; fat- 22.38±0.228 to 12.02±0.630mg/100mg) but amino acids increased significantly in the control (66.49%) after 28 days of exposure period (94.84%). Data evolved from the study were recorded and discussed with similar works in this chapter. Chapter 6 deals with the haematological changes induced by the toxicity of copper and zinc in the fish. There was a significant decrease ($p=0.001$) in erythrocyte count of *Puntius parrah* after exposure to sublethal concentration of copper and zinc. The white blood cell count showed significant increase whereas hemoglobin, haematocrit, mean corpuscular volume and mean corpuscular haemoglobin concentration decreased significantly after 28 days of exposure to the heavy metals. The tables and figures presented reveal the significant changes in different blood parameters and are discussed with recent and past literature.

Chapter 7 presents the summary of the work that is described in the earlier chapters. It is accompanied by the bibliography. The quintessence of the study is that, the specific problem associated with the heavy metals in the environment is their accumulation through food chain and persistence in nature. What are most needed in ecotoxicology are the accumulation of high quality knowledge and the structuring of that knowledge around rigorously tested explanatory principles. This study is an attempt to transform the chimerical state of knowledge into investigations which must slowly foster conciliation of explanatory paradigms among levels of organizations. For this the collaborative and synchronized contributions of the policy makers, planners, scientists, government organizations and common man are needed. Thus effective management strategies are to be evolved and implemented to protect our water bodies and aquatic organisms from the arms of heavy metal pollution and its toxic effects.